DOCUMENT RESUME

ED 054 552	24	EC 033 172
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TITLE	Long-Term Perceptual Memory in Educable and Trainable Retardates and Children with Learning Disabilities. Final Report.	
INSTITUTION	Purdue Univ., Lafayette, Ind.	
SPONS AGENCY	Office of Education (DHEW), Washington, D.C. Bureau of Research.	
BUREAU NO	BR-8-E-174	
PUB DATE	Jun 70	
GRANT	OEG-5-9-245174-0024(010)	
NOTE	14p.	
EDRS PRICE	MF-$0.65 HC-$3.29	
DESCRIPTORS	Educable Mentally Handicapped; *Exceptional Child Research; *Learning Disabilities; *Memory; *Mentally Handicapped; Trainable Mentally Handicapped; *Visual Perception	

ABSTRACT

Three short studies were conducted on long-term effects of visual perception training on perceptual memory, involving the visual illusion of apparent movement, in educable and trainable mentally retarded children (EMR and TMR) and in learning disabled children (LD). Variables were lengths of training session and retention interval. Tables presented information on subjects and experimental conditions for the three studies, number of children reporting arrow-to-square movement in training session, and number of children reporting movement in arrow-to-arrow series in test session. Test results of the first study of 36 EMRs and 24 normal children indicated that EMRs must receive more perceptual training experience than normal children of the same mental age to establish enduring perceptual memory. Results of the second study with 80 LDs suggested that LDs showed a deficit in long-term perceptual memory similar to that found for EMR and TMR populations, indicating a possible common learning problem, independent of intellectual functioning level. Test results of the third study with 24 TMRs indicated a trend toward reduction in effects of dissimilar-form training over 24 hours. (CB)

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The research reported herein was performed pursuant to a contract with the Office of Education, U.S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

U.S. DEPARTMENT OF
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Acknowledgments

The author is grateful for the cooperation of the Tippecanoe School Corporation, especially Mr. Kenneth Thayer, the Wabash Center for the Mentally Retarded, Inc., Mr. James Tilton, Director, and the Achievement Center for Children, Purdue University, especially Dr. Earl J. Heath and Mr. John Van Vactor. The research assistance of Mr. John B. Bond, Jr., Miss DeLoyce Cooke, Miss Louella J. Fong, Mrs. Carol P. Kleemeier, and Mr. Solomon Kasimer was of great help. Also, excellent secretarial service was provided by Miss Lynn in and Mrs. Anne Smith.

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Summary

This project investigated the long-term effects on visual perception of training received in a single, brief experimental session. The research used the illusion of apparent visual movement to ascertain whether educable and trainable mental retardates required more training to establish enduring visual memory, and whether the influence of such memory on perception was lost more quickly by these children than by normals. A group of children with learning disabilities was included to see whether this type of difficulty affected long-term perceptual memory. Appropriate groups of normal children were used as control subjects.

The research provides information about the way in which memory resulting from controlled prior visual experience influences how educable and trainable mental retardates and children with learning disabilities see their world. This information will aid teachers and educators concerned with special education and learning disabilities to understand the influence of visual memory, and how much training may be required to make this influence long-lasting.

The visual illusion of apparent movement--movement perceived in the absence of real movement, such as in the cinema--was used to study long-term perceptual memory. The experimental paradigm included a training session, a retention interval, and a test session. By varying the length of the retention interval, it was possible to assess the long-term effects of the perceptual experience received in the test session. The amount of experience provided in the training session was also varied, and provided an indicator of how much training was necessary for the memory to endure for different periods of time.

In the training session, all subjects were shown a film containing 30 or 60 repetitions of an arrow and square presented in sequence. Since the two sequentially-presented forms were very different, most subjects did not see them as stationary; apparent movement was not seen (Orlansky, 1940; Squires, 1959; Raskin, 1968, 1969 a, b). Either 3 minutes or 24 hours later, the initial form, the arrow, was presented in sequence with an identical arrow, a condition in which apparent movement is usually seen by normal adults and children (Raskin, 1968, 1969 a, b). Whether the training experience had a lasting effect was indicated by the number of reports of movement or no movement by each group of subjects. If the effect endured, then the subjects reported two successively-presented, stationary forms. If not, apparent movement was seen. Raskin (1969b) found that educable retardates tend to see movement in the test session while normals do not. He hypothesized that either the memory influence does not endure for as long in educable retardates, or that more experience is required for it to endure. The proposed study was designed to provide information about the validity of either or both of these assumptions.

It was found that EMRs must receive much more training experience than normals of the same MA in order to establish enduring perception memory. If insufficient training was given, memory did not endure. Learning disabled children showed a deficit in long-term perceptual memory similar to that found for EMRs, indicating that such may underlie some of their common problems. The occurrence of this deficit in both the LD and MR populations suggests that a specific type of learning problem, independent of level of intellectual functioning, may be shared by these groups.

Introduction

This project was concerned with the long-term perceptual memory of educable and trainable retarded children (and young adults) and children with learning disabilities. The implications arising from previous research by the present author with normal adults and children and educable retarded children (Raskin, 1968, 1969a, 1969b) was investigated. The illusion of visual apparent movement was used to study the effect of controlled prior experience on the perceptual processes of these children. Apparent movement is perceived when, under certain temporal conditions, the successive presentation of a pair of stationary visual forms separated in space evokes the impression of movement; it is perceived movement in the absence of real movement. There have been several studies of apparent movement with normal children (Meili & Tobler, 1931; Gantenbein, 1952; Brenner, 1957; Pollack, 1966), and with retarded and/or brain-damaged children (Werner & Thuma, 1942; Brenner, 1956; Mark and Pasamanick, 1958; Spivack & Levine, 1961; Ball and Wilsoncroft, 1967). For the most part, these have dealt with physical parameters of the illusion such as threshold determination and range of movement, and how these factors vary with age or retardation. This illusion has not been used as a tool for the study of long-term memory.

There have been no studies concerned with long-term perceptual memory in retardates and children with learning disabilities. Despite the obvious theoretical and practical importance of such work, most studies of long-term memory in retardates have dealt with verbal learning and not with the way in which memory influences the way the retarded child sees his world. Belmont (1966) reviewed the literature on long-term memory in retardates. He noted that the investigations range widely in terms of the variables under consideration, the subject populations, and the materials and methods employed.

While Belmont did not report any studies that dealt with memory effects in perception, recent work by the present investigator has been concerned with this topic in both normal and retarded children and adults. My doctoral dissertation (Raskin, 1969a), conducted at McGill University under the direction of D. O. Hebb, was a study of the effect of prior experience on the perception of apparent movement. A basic factor in the perception of this phenomenon is the similarity or difference in shape of the two stimulus forms used to produce the illusion. If the two forms are identical or very similar, movement from one position to the other is usually seen (Orlansky, 1940; Squires, 1959). However, I found that specific training and the subsequent memory traces may negate the effect of either similarity of difference in shape. Adult subjects who were given prior experience with a form in apparent movement later saw that form move when it was presented in sequence with a very dissimilar form. Control subjects without the same training did not see this movement. Other subjects were given preliminary training

with dissimilar forms presented in the apparent movement paradigm, two successively-presented stationary forms were seen. Later, the initial form was presented in sequence with an identical form but these subjects did not see movement. The effects of the training in both of the situations were long-lasting; they were present as long as one week after training, and were interpreted in terms of perceptual learning and long-term memory. A later study (Raskin, 1968), showed that there were no developmental differences among normal children and adults. This indicated that 6-year-old children were equal to older children and adults in the ability to retain previously-presented visual information, and their perception was strongly influenced by this information. However, when normal children and educable familial retardates were matched according to MA (Raskin, 1969b), there were differences. In a training session, both normal and retarded subjects were shown a series of 30 repetitions of an arrow and square sequence. None of the groups reported that the arrow moved to the square. Twenty-four hours later, when shown a series of arrow-arrow sequences that usually produce the illusion of movement, most of the normal children reported stationary arrows; most of the retarded children reported moving arrows. This latter finding was so very different from the highly reliable results in normals that further investigation seemed warranted.

This research investigated the two equally-plausible explanations of why most of the retardates saw the illusion of movement in the test session. The first of the two was that the retarded children may require more experience in the training session to establish enduring memory traces than do normals. The second is that there was faster decay of the memory trace in retardates than in normals. Shorter retention intervals and greater amounts of experience in training will be employed in an attempt to ascertain whether either, or both, of these assumptions is tenable. Also, groups of trainable retarded and children with learning disabilities were studied under previously-used conditions in order to study their perceptual memory processes.

Methods

Materials. The stimulus shapes were pairs of white solid forms presented by 16 mm. motion picture film with a Kodak Analyst Projector. Each pair, two identical arrows and an arrow and square, was projected at 24 frames per second. Each presentation of either pair consisted of a 51 millisecond exposure of the left form (arrow) followed 5.4 milliseconds later by the right form (arrow or square), and then by 1¼ seconds of blank film, the inter-repetition interval. Each form had a projected length of 3½ inches, and the spatial separation between the left and right forms was also 3½ inches. The fixation point, a 1½ inch diameter black circle, was attached to the screen ½ inch below the lower left border of the left stimulus form.

Subjects:

Study 1. Thirty-six children in special education classes (EMRs, average CA = 13-7, MA = 8-10, and IQ = 73.0), 24 normal third graders (avg. MA and CA = 9-0, IQ = 98.2) served as subjects. All were given the Peabody Picture Vocabulary Test as an additional screening device prior to the research.

Study 2. Eighty children, between the ages of 6-8 and 12-8, served as subjects. All were diagnosed as having learning disabilities by the Achievement Center for Children at Purdue University. All had IQs of at least 85 as measured by standard intelligence tests; none were retarded, grossly brain damaged, or epileptic.

Study 3. Twenty-four trainable retarded adolescents and young adults were used as subjects. All were workers in the Sheltered Workshop at the Wabash Center for the Mentally Retarded, Inc., Lafayette, Ind. They were given the PPVT as a prelude to research. Average CA, MA, and IQ were 19-6, 10-6, and 64.4, respectively, with interpolated scores used when necessary.

Procedures.

Testing took place in a darkened room with the subject seated 11 feet from the screen. Each was instructed to watch the film while trying to keep his eyes on the black circle, the fixation point. Three minutes of dark adaptation followed, and then each subject was shown the training series. The amount and type of training experience, the retention intervals, and the assignment of subjects to the various conditions are shown in Table 1. As may be seen, the testing condition for all subjects except for two LD groups was the viewing of 30 repetitions of the arrow-arrow series. Two LD groups received arrow-arrow training. This has been found to facilitate the subsequent perception of movement in the arrow-square series (Raskin, 1969a).

Table 1. Subjects and experimental conditions

Study	Subjects	N	Training Amount	Training Forms	Retention Interval
1	EMR	12	30	arrow-square	3 min.
	EMR	12	30	"	24 hr.
	EMR	12	60	"	24 hr.
	Normal	12	30	"	3 min.
	Normal	12	30	"	24 hr.
2	LD	20	30	"	3 min.
	LD	20	30	"	24 hr.
	LD	20	30	arrow-arrow	3 min.
	LD	20	30	"	24 hr.
3	TMR	12	30	arrow-square	3 min.
	TMR	12	30	"	24 hr.

In both training and test sessions, the subject was asked to report what he saw and to demonstrate it with his hands at the screen. Verbal reports were recorded verbatim and, for both the verbal and demonstrated report, classified as to whether movement was seen or not. The demonstrated report was used to check the verbal report and was given priority in the event that the verbal report was equivocal.

Results and Discussion:

Study 1: EMR and Normals.

Chi-square with Yates's correction for continuity was used to test for differences between the number of reports of movement and no movement in the training and test sessions. It was necessary, in research with adults (Raskin, 1969a), to analyze the reports according to whether any seen movement was complete or partial. However, in the present study all of the responses were dichotomous; there were either reports of movement or no movement, none of partial movement. Perhaps this was owing to a lack of verbal sophistication on the part of the children or was truly a perceptual phenomenon.

In the arrow-square training session, there were no significant differences between EMRs and normals in numbers of reports of arrow-to-square movement. Eleven of the 12 EMRs and 10 of the 12 normals in the 30 repetition, 3-min. interval groups did not report movement. All of the 12 normals and 10 of the 12 EMRs in the 30 repetition, 24-hr. groups reported "no movement." Similarly, 10 of the 12 EMRs who received 60 repetitions as training did not report movement.

More important was the finding that in the test session there were no differences between normals and EMRs given 30 training repetitions in reports of movement with the arrow-arrow series given 3 min. later. Eight of 12 EMRs and 10 of 12 normals did not see movement. This indicates that the training given both groups was sufficient to hinder their perception of this illusion following a very short retention interval. However, there were differences between normals and EMRs in the 30 repetition, 24 hr. interval groups. While 10 of the 12 normals reported no movement, only 3 of the 12 EMRs did so. This difference in number of reports of no movement in the arrow-arrow film was statistically significant ($\chi^2_{(1)} = 6.08$, $p < .02$), substantiating the previous finding that the influence of this amount of training experience does not endure 24 hr. in EMRs (Raskin, 1969b). On the other hand, 9 of the 12 EMRs who received 60 arrow-square training repetitions did not see movement in the arrow-arrow test 24 hr. later, clearly showing the effect of the extra training experience. This number of children was significantly different from those EMRs with the same retention interval but half as much training ($\chi^2_{(1)} = 4.17$, $p < .05$) but was not statistically different from the 30 repetition, 3-min. normals.

The present results show that perceptual memory established by 30 repetitions of the training given in this experiment will affect the perception of apparent movement by EMRs and normal children following a short retention interval. However, as reported previously (Raskin, 1969b), this is not true for the EMRs after a 24-hr. delay. Also, the results indicate that EMRs must receive much more training than equal-MA normals in order to establish longer lasting perceptual memory.

The fact that prior experience and perceptual memory affect the perception of apparent movement may be interpreted in terms of association perceptual learning (Raskin, 1969a). When training links the peoperty of nonmovement to the initial form, the resulting memory effects arising from this training will interfere with the perception of movement under otherwise optimal conditions. The present results show that EMRs will differ from normals in this type of perceptual learning and the resulting long-term effects only if they are tested following, what is for them, inadequate training. However, if the original material is presented many more times there should be no difference in retention following a longer period of delay. The results also indicate that, although memory may influence perception following a short retention interval, it will not necessarily exert an effect after a longer delay in the retardate. What may be considered to be overlearning may be required to ensure that memory traces will endure.

Study 2: Learning Disabled.

The number of children in each group who reported movement in the training and test series was recorded and analyzed using Chi-square with Yates's correction for continuity. The results shown in Table 2 are the number of reports of movement in the arrow-square series for the four groups. These are the test results for those children with arrow-arrow prior experience and the training results, without experience, for the others. As may be seen, significantly more children with identical-form training saw the arrow move toward the square (ps $< .01$). The results indicate that, as for normal adults and children, 30 repetitions is sufficient to establish the facilitating effects of identical-form training in LDs and these endure 24 hr.

The reports of movement and no movement for the arrow-arrow series are shown in Table 3. These are the test results for children with prior exposure to the arrow-square sequences and the training results for the others. Significantly more children in the 3-min. group with dissimilar-form experience did not see movement than did those who saw this series first ($\chi^2_{(1)} = 10.03$, $p < .01$). This

indicates that the amount of nonmovement training was sufficient to hinder the perception of this illusion in LDs after a short retention interval. On this task, these children behaved as did normal adults and children and EMRs (Raskin, 1970). However, there was no difference between the two groups of 24-hr. interval children, indicating that the dissimilar-form prior training had no effect; the perception of the illusion was not hindered. These children behaved as did the EMRs in an earlier study (Raskin, 1969b)--they saw an illusion that others with the same training did not.

The results of the present study indicate that LDs may show a lack of inhibitory control in certain long-term perceptual memory situations similar to that found in their general behavior. Furthermore, these children and EMRs may indeed share a specific perceptual learning problem with respect to the absence of an enduring hindering effect of training on the perception of apparent movement. On the other hand, when the training may be expected to exert a facilitating influence upon the later perception of the illusion, LDs exhibit normal perceptual memory effects.

Table 2.--Number of Children Reporting Arrow-to-Square Movement

Interval	Training Group	Reports		Chi-square[a]
		Movt.	None	
3-min.	Identical Forms	15	5	10.03*
	Dissimilar Forms	4	16	
24-hr.	Identical Forms	13	7	7.30*
	Dissimilar Forms	5	15	

[a]with Yates's correction for continuity

*$p < .01$

Table 3.--Number of Children Reporting Movement in the Arrow-Arrow Series

Interval	Training Group	Reports		Chi-square[a]
		Movt.	None	
3-min.	Identical Forms	17	3	10.42*
	Dissimilar Forms	7	13	
24-hr.	Identical Forms	18	2	3.33 (ns)
	Dissimilar Forms	12		

[a]with Yates's correction for continuity

*$p < .01$

Study 3: Trainable Retardates.

The reports of movement and no movement in the training and test sessions were analyzed with Chi-square with Yates's correction for continuity. In the training with the arrow-square series, 9 of the 12 subjects in the 3-min. interval group and 10 of 12 in the 24-hr. group did not see movement. The test results with the arrow-arrow film, while not statistically significant ($p > .05$), clearly show a trend toward a reduction in the effects of the dissimilar-form training over 24 hrs. While only 3 of the 12 in the 3-min. interval group saw the arrow move across the screen, 8 of 12 in the 24-hr. group did so. Thus, the trend by the TMRs was toward seeing movement after 24 hrs., a tendency not present in normals (Raskin, 1968, 1969a).

Conclusions:

The studies reported here have shown that EMRs must receive much more perceptual training experience than normals of the same MA in order to establish enduring perceptual memory. Also, if less training is given, short-term effects will be present following a brief retention interval but these will not last over longer times. Thus, the conclusion seemed reasonable that the retention of normals and EMRs will not differ if the latter group is given more training.

The investigation of long-term perceptual memory in children with learning disabilities indicates that they may show a lack of inhibiting control in certain long-term perceptual memory situations that is similar to that found in their general behavior patterns. The results also show a deficit in a specific perceptual phenomenon that is present in EMRs and TMR and may thus underlie some of their common difficulties. The lack of inhibiting effects of the dissimilar form training in the retardates and LDs suggests a specific type of learning problem that may be independent of level of intellectual functioning but may be complicated when in conjunction with retardation.

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Footnote

[1] The population of the Wabash Center for the Mentally Retarded, Inc. has changed since the proposal was submitted. Therefore, the age of the subjects was not as anticipated nor were as many subjects available.

Appendix A.

An additional study was conducted using the PPVT test scores collected as a prelude to the research reported in this paper. The summary of this research follows. Reprints of the article that appeared in Psychological Reports, 1970, 26, 547-549 are available from the author.

TEMPORAL STABILITY OF THE PPVT IN NORMAL AND EDUCABLE-RETARDED CHILDREN

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Summary.--The temporal stability of the PPVT, Form B, was investigated for two age groups from regular normal and special education classes (EMRs). The second administration of the test occurred 6 mo. after the first, following summer holidays. Analysis indicated that only the older normal Ss showed significant changes in MA, gaining 14 mo. Test-retest correlations ranged from .66 to .92.